Summary of

Clinical Pathology

These notes contain:

* Schemes for:
  - CBC report, urine report and liver profile report
* Tables of differential diagnosis for:
  - Urine report, cardiac enzymes, CSF report, glucose tolerance curves and hepatitis markers
* Diagrams for cardiac enzymes, glucose tolerance curves and Hepatitis Markers

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Special Thanks to
Dr Ashraf Zaki

CBC Report

Table Parameters of CBC Report

RBCs

Parameters	Normal	Abnormal	Significance
RBCs count	5 million /cmm	If the 3 parameters are increased	Polycythemia
Hemoglobin	15 gm %	If the 3 parameters are decreased	Anemia
Hematocrite (PCV)	45 %		
Mean Corpuscular Diameter (MCD)	6-8 Micrometer	If the 2 parameter are increased	Macrocytic
Mean Corpuscular Volume (MCV)	76-96 (90) fl	If the 2 parameter are normal	Normocytic
		If the 2 parameter are decreased	Microchromic
Mean Corpuscular Hemoglobin (MCH)	27-32 (30) pictogram	If the 2 parameter are increased	Hyperchromic
Mean Corpuscular Hemoglobin concentration (MCHC)	34 gm %	If the 2 parameter are normal	Normochromic
		If the 2 parameter are decreased	Hypochromic
Reticulocytes	0.5-2 %	Reticulocytosis	1.Hemolysis 2.Hemorrhage 3.Anemia under treatment 4.Recovery from bone marrow depression

WBCs – Total Leucocytic Count (TLC)

Parameters	Normal	Abnormal	Significance
TLC	4,000-11,000/cmm		
Neutrophils	60-70 %	If > 70 %	Neutrophilia
		If < 60 %	Neutropenia
Esinophils	3-5 %	If > 5 %	Esinophilia
		If < 3 %	Esinopenia
Lymphocytes	20-30 %	If > 30 %	Lymphocytosis
		If > 20 %	Lymphocytopenia

Platelet

Parameters	Normal	Abnormal	Significance
Platelet count	150,000-450,000/cmm	If > 450,000/cmm	Thrombocytosis
		If < 150.000/cmm	Thrombocytopenia
Staff:segmented	1:5-10	If 1:<5	Shift to left
		If 1:>10	Shift to right
Basophils	0-1 %	If > 1 %	Basophilia
Monocytes	3-8 %	If > 8 %	Monocytosis
		If < 3 %	Monocytopenia

Table Scheme for CBC Report

RBCS

Step I	Look at RBCs count, Hemoglobin concentration, Hematocrite						
Normal	5 million /cmm, 15 gm %, 45 %						
If	The 3 parameters are ↑		The 3 parameters are ↓				
So	Polycythemia		Anemia				
Step II	Look at TLC, Platelet count			Look at MCV, MCD, MCH, MCHC			
Normal	4,000-11,000 / cmm, 150,000-450,000 / cmm			90 fl, 6-8 Micrometer, 30 pg, 34 gm %			
If	↑ TLC ↑ platelet	Normal TLC Normal platelet	If all ↑↑	If all normal		If all ↓↓	
So	Primary polycythemia	Secondary polycythemia	Macrocytic normochromic anemia	Normocytic normochromic anemia		Microcytic Hypochromic anemia	
Step III	Look at TLC, platelet, staff:segmented					Look at esinophils	
If	↓ TLC, ↓ platelet, shift to right		All normal or ↑↑ Shift to left		All ↓↓	If > 5 %	If 3-5 %
So	Macrocytic anemia		Hemolysis or acute hemorrhage		Aplastic anemia	Ankylostoma infestation	Iron deficiency anemia
Further investigations	Serum vit B12 Serum folic acid		Confirm by retculocytic count				Serum iron Serum ferritin Total iron binding capacity
			↑↑		↓↓		
			Look at coagulation time				
			If > 8 min, so hemorrhagic				

WBCs

Step I	Look at TLC						
Normal	4,000-11,000 / cmm						
If	> 50,000 /cmm			11,000-50,000 / cmm		< 4,000 / cmm	
So	Leukemia			Leucocytosis		Leucopenia	
Step II	Look at blast cells			Look at differential count		Neutrophils	Lymphocytes
Normal						60-70 %	20-30 %
If	Predominant		Not Predominant	Neutrophils > 70 %	Lymphocytes > 30 %	Neutrophils < 60 %	Lymphocytes < 20 %
So	Acute leukemia		Chronic leukemia	Neutrophilia with relative lymphocytopenia	Lymphocytosis with relative neutropenia	Neutropenia with relative lymphocytosis	Lymphocytopenia with relative neutrophilia
Step III	Determine whether myeloblasts or lymphoblasts are predominant Look at peroxidase stain		Determine whether myelocytes or lymphocytes are predominant		For leucocytosis & leucopenia, determine staff:segmented, so shift		
If	Predominant myeloblasts +ve peroxidase	Predominant lymphoblasts -ve peroxidase	Predominant myelocytes	Predominant lymphocytes	1:>10		1:<5
So	Acute myeloblastic leukemia	Acute lymphoblastic leukemia	Chronic myeloid leukemia	Chronic lymphocytic leukemia	Shift to right		Shift to left
Step IV						For leucopenia,look at RBC, platelet	
If						Normal	↓
So						Leucopenia	pancytopenia

Platelets

Step I	Look at platelets count	
Normal	150,000-450,000 /cmm	
If	> 450,000 /cmm	< 150,000 /cmm
So	Thrombocytosis	Thrombocytopenia
Step II	Look at bleeding time (normal: 2-4 min)	
If	> 4 min, so 2 possibilities	
So	1. ↑ bleeding time is result of thrombocytopenia due to aplastic anemia	2. ↑ bleeding time due to purpura

Urine report

Table — Items to comment on in a urine report

1. Volume of urine	**Normal**	1000-15000 cc/24 h			
Abnormalities	**>1500 cc/24 h, Polyuria**				
	Causes	**Diabetes mellitus**	**Diabetes insepidis**	**Chronic renal failure**	**Functional poluria**
	Specific gravity	High, > 1025	Very low, 1002	1010, fixed	Low
	others	Sugar	Huge volume	Granular casts	Normal
	< 800 cc/24 h, Oliguria				
	Causes	**Nephritic syndrome**		**Acute renal failure**	**Functional oliguria**
	Specific gravity	High		1010, fixed	High
	others	RBCs & red casts		Granular casts	Normal
2. Specific gravity	**Normal**	1015-1025			
Abnormalities	**1. High**	**Diabetes Mellitus** **Nephritic syndrome**			**Functional oliguria**
	2. 1010, fixed			**Chronic & acute renal failure**	
	3. Low		**Diabetes inspidis**		**Functional polyuria**

3. Color & aspect	Amber yellow	Watery	Brownish	Turbid	Smoky		Red	Milky
	Normal	**Polyuria**	**Jaundice**	**Infection**	**Nephritic syndrome,** nephritic syndrome		**Hematuria**	**Chylurea**

	4. Reacrion of urine	5. Albumin (protein)	6. Sugar	7. Ketone bodies (acetone)
Normal	Acidic 5.5-6.5	Nil	Nil	Nil
Abnormal	**Alkaline urine: indicates infection & explain phosphate crystals**	**+, ++: Most of kidney disease** **+++, ++++: Nephrotic syndrome**	**+,++,+++,++++: diabetes mellitus or renal glucosuria**	**+, ++, +++: ketonurea in diabetes mellitus**

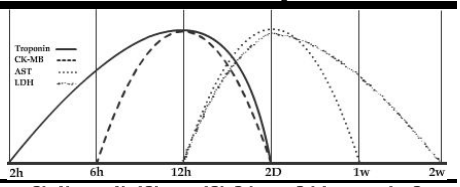
	8. RBCs	9. Pus cells	10. Bile pigment	11. Crystals		12. Casts	
Normal	0-4 / HPF	0-4 / HPF	Traces	Nil		Nil or hyaline	**Normal**
Abnormal	> 4 / HPF, hematuria	4 / HPF	Increased jaundice	Oxalate & urate	Phosphate	Red	**Nephritic syndrome**
Significance	**Prerenal: purpura, coagulation defects** **Renal: nephritic, cancer** **Postrenal: stone, oxaluria, cancer**	**Pyelonephritis: with white casts** **UTI: without white casts**	**in obstructive, hepatocellular**	In acidic urine	In alkaline urine	White	**Pyelonephritis**
				Crystals may be the cause of hematuria		Fatty	**Nephrotic syndrome**

Table — Differential diagnosis for urine report

	Nephritic	Nephrotic	CRF	ARF	Diabetes mellitus	Diabetes Insipidus	Functional polyurea	Functional oligurea	Obstructive jaundice	UTI	Pyelonephritis	Post-renal hematuria
Volume	Oligurea		Polyurea	Oliguria	Polyurea	Polyurea (huge)	Polyurea	Oligurea				
Sp. Gr.	High		1010, fixed	1010, fixed	High	Very low, 1002	Low	High				
Aspect	Smoky	Smoky	Watery			Watery	Watery		Brownish	Turbid	Turbid	Red
Protein	+/++	+++/++++	+/++	+/++						+/++	+/++	+/++
Sugar					+/++/ +++/++++							
Ketone					May be present							
Cells	RBCs>4/HPF	Epithelial	Epithelial	Epithelial						Epithelial Pus cells > 4/HPF	Epithelial Pus cells > 4/HPF	RBCs>4/HPF
Casts	Red casts	Fatty casts	Granular casts	Granular casts						NO white casts	White casts	
Bilirubin & bile pigment									Present			
NBs	ARF may occur on top of nephritic				If associated with high protein, so diabetic nephrosis						ARF may occur on top of nephritic	Crystals

Cardiac enzymes and proteins

Table — Scheme for cardiac enzymes



	2h-6h	6h-12h	12h-2d	2d-1w	1w-2w
Troponin	↑	↑	↑		
CK-MB		↑	↑		
AST			↑	↑	
LDH			↑	↑	↑

CSF Reports

Table — Differential diagnosis for CSF reports

	Normal					
Protein	20-40 mg %	↑	↑	↑	↑	↑
Sugar	40-80 mg %	↓↓↓	↓	Normal	Normal	↑
Pressure	80-120 mg %	↑	↑	↑	↓	↑
Color	Watery	Very turbid	Slight turbid	Colorless	Yellowish	Red
Cells	RBCs 0-4/HPF					↑
	WBCs 0-4/HPF	↑ Neutrophils	↑ Lymphocytes	↑ Lymphocytes	Normal (cytoalbuminous dissociation)	
Chloride	115-130 mmol/L	↓	↓↓↓	Normal	Normal	
Diagnosis	**Normal**	**Septic meningitis**	**Tuberculous meningitis**	**Viral meningitis**	**Subarachnoid block**	**Hemo-rrhage**

Blood glucose

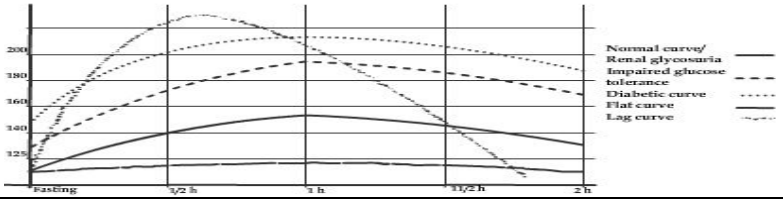
Table — Blood glucose

	Normal	Impaired glucose tolerance	Diabetes mellitus
Fasting blood sugar	< 126 mg/dl	126-140 mg/dl	> 140 mg/dl
2 hour Post-prandial blood sugar	< 140 mg/dl	140-200 mg/dl	> 200 mg/dl

Glucose tolerance curve

Table — Glucose Tolerance Curve

	Normal	Renal glycosuria	Impaired glucose tolerance	Diabetic curve	Flat curve	Lag curve
Fasting	< 126 mg/dl	< 126 mg/dl	126-140 mg/dl	>140 mg/dl		< 126 mg/dl
Peak	< 160 mg/dl	< 160 mg/dl		>200 mg/dl	< 126 mg/dl	> 200 mg/dl
2h PP	< 140 mg/dl	< 140 mg/dl	140-200 mg/dl	>200 mg/dl		< 140 mg/dl
Sugar	Nil	+	Nil	+, ++, +++, ++++	Nil	Nil
Significance	Normal test	Decreased renal threshold for glucose	Impaired glucose tolerance	Diabetes mellitus	Malabsorption Myxedema, addison's, hypopituitarism	Gastrectomy, gastroenterostomy Hyperthyroidism Chronic liver disease



Liver profile reports

Table — Parameters of liver profile

Liver profile

Parameters	Normal	Abnormal	
Total proteins	6-8 gm%		
Albumin	4-5 gm %	↓	—
Globulin	2-3 gm %	↑	↑
A/G ratio	2:1	Reversed	Impaired
Significance		Chronic liver disease	Acute liver disease

Parameters	Normal	Abnormal		
Total bilirubin	0.1-1.0 mg %	↑		
Direct bilirubin	15% of total	>15 %		Both
Indirect bilirubin	85 % of total		>85 %	
Significance		Cholestasis	Hemolysis	Liver failure

Serum enzymes

Parameters	Normal	Abnormal	Significance
Serum AST	Up to 32 U/L	↑↑	Chronic liver disease
Serum ALT	Up to 31 U/L	↑↑	Acute liver disease
Alkaline phosphatase	80-240 U/L	↑	Liver cirrhosis
		↑↑↑	Cholestasis

Parameter		Normal	
Prothrombin concentration		100%	
Alfa fetoprotein	Normal	Abnormal	Significance
	0-10 ng/dl	10-400 ng/dl	Hepatitis (or cirrhosis) or hepatoma
		>400 ng/dl	Hepatoma

Table — Scheme for Liver Profile Reports

Step I	Look at total bilirubin		
If	Normal	Increased	
So	Proceed to step III	Proceed to step II	
Step II	**Look at direct bilirubin & calculate indirect bilirubin**		
If	Both direct & indirect elevated	Mainly indirect elevared	Mainly direct elevated
+ findings		All other findings are normal	Very HIGH alkaline phosphatase ↓ prothrombin
So	Proceed to step III	Hemolysis or Familial non hemolytic hyperbilirubinemia	Cholestasis

Step III	Look at AST, ALT, alkaline phosphatase, prothrombin	
If AST	↑↑	–
ALT	–	↑↑
Alk. Phase	↑	↑↑↑
Prthrmbn	↓	–
So	Chronic hepatitis	Acute hepatitis
Step IV	**Look at albumin**	
If	↓	Normal
So	With decompensated cirrhosis	—

It is recommended to use this 'Summary of Clinical Pathology', after studying your notes

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Hepatitis markers

Table — Markers for HAV, HCV, HDV, HEV, HBV

	PCR	Antibodies	
Hepatitis A markers	—	HAV IgM	HAV IgG
Significance		Recent infection	Old infection
Hepatitis C markers	HCV RNA	HCV Ab	
Significance		Post exposure to HCV with 85 % carrier	
Hepatities D markers	HDV RNA	HDV IgM	HDV IgG
Significance		Recent infection	Old infection
Hepatitis E markers	—	HEV IgM	HEV IgG
Significance		Recent infection	Old infection
Hepatitis B markers	HBV DNA	Look after	

Table — Differential diagnosis for HBV markers

HBsAg	Positive	Negative	Negative	Positive	Negative
HBsAb	Negative	Negative	Positive	Positive	Positive
HBcAb IgM	Positive	Positive	Positive or Negative	Negative	Negative
HBcAb IgG	Positive or Negative	Positive	Positive	Negative	Negative
	Acute HBV infection	Window phase of HBV infection	Previous HBV infection with recovery & immunity	Carrier for HBV	HBV vaccination

HBeAg: +ve indicates high Infectivity